Remarks

Thorough examination by the Examiner is noted and appreciated.

The Specification has been amended to correct grammatical/typographical errors.

The claims have been amended and new claims added to more clearly claim Applicants invention. Support for the amended and newly drafted claims are found in the original claims and/or specification. Specifically, support for amended claims 25, 32 and new claim 35 is found in the Specification at paragraphs 0044, 0045, beginning on page 25:

"After removing bottom image photoresist layer 20, **a contact hole is etched through via opening 28 thereby extending the via opening 28 through the metal nitride etching stop layer 16** to substrate 12 by a conventional RIE etching process for etching metal nitrides according to process flow step 311 (stop layer etch) and as shown in Figure 1G. In the RIE process to etch a contact hole through the etching stop layer 16, a conventional etching process may be used, for example, including a mixture of hydrofluorocarbons, for example, a plasma gas source including a mixture of C_2F_6, CH_2F_2, and C_4F_8.

"Following RIE etching of the etching stop layer 16, according to one embodiment of the present invention the **plasma reactor chamber is subjected to an in-situ plasma cleaning process according to process** step 313 to clean the plasma reactor chamber surfaces (plasma contact surfaces) to substantially the

initial starting condition. The in-situ plasma cleaning process preferably includes plasma reactor etching conditions as previously outlined for the first and second ashing process to **include a nitrogen and/or fluorine containing plasma**."

Support for new claim 36-38 is found in the Specification at paragraphs 0038, 0039, beginning on page 20:

"According to the present invention, the dry development process is **preferably performed in a dual RF power source plasma reactor**, for example, a high density plasma reactor such as an inductively coupled plasma (ICP)reactor or transformer coupled plasma (TCP) reactor.

Turning to Figure 2, portions of an exemplary dual RF plasma reactor 200 are shown including a first RF power source 202 for plasma excitation in plasma chamber 205 by induction coil 204 through dielectric window 206. A **second RF power source 208 attached to wafer chuck 210 holding semiconductor wafer 212 operates as a bias** for accelerating ions to bombard the substrate surface 214."

The remaining amendments and newly drafted claims find support in the original claims and/or the specification. No new matter has been entered.

Claim Rejections under 35 USC 112

Claims 25-31 have been amended or cancelled to overcome Examiners rejection under 35 USC 112, first paragraph.

Claim Rejections under 35 USC 102(e)

Claims 1, 3, 5-13, 20, 21, 23-31 stand rejected under 35 USC 102(e) as being anticipated by Ohuchi (U.S. 6576562).

Ohuchi discloses a method for forming an etched opening in a substrate using a mask material including a carbon content of 80% or more (see Abstract). In Figures 7A through 7F (columns 29-31), Ohuchi discloses and teaches a method for forming an etched opening e.g., a dual damascene using a bi-layer methodology with the upper layer a resist layer.

Ohuchi critically teaches the use of a lower organic layer film has a carbon content of greater than about 80% to provide an increased etching resistance (e.g., col 24, lines 11-54, col 29, lines 33-34) and an upper photoresist film including a metal or semiconductor component disclosed to be silicon, aluminum, titanium, tungsten, and germanium (col 29, lines 44-45).

Ohuchi, by teaching various metals in the alternative to silicon teaches away from Applicants disclosed and claimed invention which is limited to a silicon containing resist, for example, such metals other than silicon may have an adverse effect on light absorption at the wavelengths 157 and 193 claimed and disclosed by Applicants in claim 25. For example, Ohuchi teaches that a conventional upper layer photoresist in the tri-

layer embodiment including an intermediate SOG layer may broadly be photoactive to a broad range of wavelengths including I-line (365 nm) and g-line (436 nm) wavelengths and (col 14, lines 42-54). Ohuchi does not disclose or teach a wavelength for exposing the metal/semiconductor containing photoresist in the bi-layer embodiment relevant to Applicants disclosed and claimed invention outlined in columns 29-31, thereby failing to disclose Applicants claimed invention and arguably teaching away therefrom.

Following patterning the upper resist layer, Ohuchi teaches that in transferring the pattern to the lower organic layer (e.g., applicants first resist layer) that the upper resist layer is removed (col 26, lines 33-35) contrary to Applicants disclosed and claimed invention. Examiner notes that the upper resist layer is removed (ashed) **during etching** of the lower organic layer. Alternatively, Ohuchi discloses that the overlying bi-layers are left in place to form an overlying wiring grove, acting to "suppress deterioration of the dielectric insulating film" (col 30, lines 55-65).

Thus, Ohuchi does not specifically teach carrying out an ashing process to remove the upper (first) resist layer **and** lower organic (second resist) layer following formation of a opening (damascene) as disclosed and claimed by Applicants in claims 1 and 25. Ohuchi also does not disclose or teach removing the

upper resist layer prior to forming the opening or removing the lower organic (first resist) layer following formation of the opening as claimed by Applicants in claims 12 and 32.

Moreover, Ohuchi does not disclose or suggest that the etching and ashing processes are carried out in-situ or suggest or disclose a plasma cleaning process following formation of the opening including etching through a bottom etch stop layer as claimed in new claims 32 and 35 and amended claim 25.

Significantly, Ohuchi does not disclose any particular thicknesses of the non-silicon containing lower organic layer and upper silicon containing resist film for forming a damascene opening as shown in Figures 7A-7F in the bi-layer embodiment relevant to Applicants disclosed and claimed invention discussed in columns 29 to 31. Ohuchi does teach, however, that the lower organic layer disclosed to be a critical part Ohuchi's invention is **thinner** than a conventional resist film due to its superior etching resistance from having a carbon content greater than 80 %, impliedly referring to the upper layer resist (see col 30, lines 37-40). In a previous unrelated embodiments for forming a gate structure, Ohuchi discloses that the lower organic layer is from 20 nm to 5,000 nm (col 3, lines 47-48), while the uppermost resist layer is from 5 nm to 10,000 nm (col 15, lines 30-32),

allowing the upper resist layer to be thicker than the lower resist layer, teaching away from Applicants claimed invention.

Examiner notes that in the tri-layer embodiment of Ohuchi including an intermediate organic silicon oxide film (SOG) (col 25, lines 9-34), that the lowermost high carbon content organic layer is formed at a thickness of 500 nm (col 24, lines 8-10), the SOG film formed at a thickness of 90 nm (col 5, lines 20-22), and the upper resist formed at a thickness of 300 nm (col 25, lines 40-43). However, the tri-layer embodiment operates by a different principal of operation than Applicants disclosed and claimed invention. For example in the bi-layer embodiment of Ohuchi, the bi-layers are taught to be left in place following etching an opening. Therefore, the disclosed thicknesses in the tri-layer embodiment cannot be said to apply to the bi-layer embodiment, where Ohuchi teaches that the lower high carbon content organic layer is advantageously thinner than a conventional photoresist (col 30, lines 37-40), which taught to be left in place following etching of the opening contrary to Applicants disclosed and claimed invention.

Nowhere in the bi-layer embodiment of Ohuchi is it taught or implied that the lower organic layer should be thicker than an upper resist layer as disclosed and claimed by Applicants with respect to first and second resist layers.

Ohuchi further specifically teaches away from using a conventional (e.g., non-silicon) photoresist (e.g., including the I-line resist disclosed and claimed by Applicant) as the lower organic layer which Ohuchi discloses has a carbon content of only about 70% carbon by weight (col 30, lines 37-39) in contrast with the method of Ohuchi critically requiring a carbon content of greater than about 80% contrary to Applicants claimed lower resist layers as claimed in claims 23, 30, and 34.

Moreover, Ohuchi does not disclose or teach anywhere that the lower organic layer can be a photoresist, as disclosed and claimed by Applicants.

Finally, Ohuchi fails to recognize or suggest a solution to the problems that Applicants have recognized and solved by their claimed invention:

"A method for <u>etching an opening</u> using a bi-layer photoresist to improve an etching resolution and reduce particulate contamination"

Ohuchi is clearly insufficient to anticipate Applicants disclosed and claimed invention.

Claim Rejections under 35 USC 103(a)

Claim 22, stands rejected under 35 USC 103(a) as being unpatentable over Ohuchi above, and further in view of Smith (U.S. Pat No. 6,388,226). The comments made above with respect to Ohuchi are reiterated.

Smith discloses an improved low-field toroidal plasma source (see Abstract). Smith discloses that the plasma source can be operated to increase the etch rate of organic materials (see Abstract). Smith generally discloses that oxygen is useful for removing photoresist in an etching process (col 1, lines 60-65) and generally discloses that adding a noble gas such as argon to a plasma can increase the output of active species (col 15, lines 29-43) for example in a nitrogen/oxygen plasma. Smith does not teach using a nitrogen/oxygen plasma to etch photoresist or disclose a bi-layer or multi-layer resist or a method for developing or etching the resist. There is no motivation to combine Smith with Ohuchi, and in any event, such combination does not produce Applicants disclosed and claimed invention.

"We do not pick and choose among the individual elements of assorted prior art references to recreate the claimed invention, but rather we look for some teaching or suggestion in the references to support their use in a particular claimed combination" *Symbol Technologies, Inc. v. Opticon, Inc., 935 F.2d 1569, 19 USPQ2d 1241 (Fed. Cir. 1991).*

"A prior art reference must be considered in its entirety, i.e., as a whole including portions that would lead away from the claimed invention." *W.L. Gore & Associates, Inc., Garlock, Inc., 721 F.2d, 1540, 220 USPQ 303 (Fed Cir. 1983), cert denied, 469 U.S. 851 (1984).*

"If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious." *In re Ratti, 270 F.2d 810, 123, USPQ 349 (CCPA 1959).*

"First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. **The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure.** *In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).*

"The fact that references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a prima facie case of obviousness without some objective reason to combine the teachings of the references." *Ex parte Levengood, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1993).*

With respect to the remaining independent claims, since neither Ohuchi nor Smith nor any combination thereof produce Applicants claimed invention, thereby failing to make out a *prima facie* case of obviousness, neither has a *prima facie* case of obviousness been made out with respect to the amended and newly drafted dependent claims.

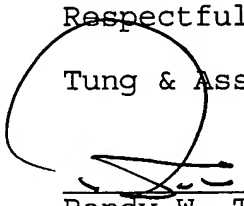
The Claims have been amended to clarify Applicants claimed invention and newly drafted claims added. A favorable consideration of Applicants' claims is respectfully requested.

Based on the foregoing, Applicants respectfully submit that the Claims are now in condition for allowance. Such favorable action by the Examiner at an early date is respectfully solicited. The Commissioner is hereby authorized to charge Deposit Account No. 50-0484 any fee due as a result of this response.

In the event that the present invention as claimed is not in a condition for allowance for any other reasons, the Examiner is respectfully invited to call the Applicants' representative at his Bloomfield Hills, Michigan office at (248) 540-4040 such that necessary action may be taken to place the application in a condition for allowance.

Respectfully submitted,

Tung & Associates



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